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LARGE-SCALE FIELD EVALUATION OF ELECTRIC INSECT  
TRAPS TO REDUCE BOLLWORM POPULATIONS IN  
REEVES COUNTY, TEXAS

Agricultural Research Service  
UNITED STATES DEPARTMENT OF AGRICULTURE

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LARGE-SCALE FIELD EVALUATION OF ELECTRIC INSECT  
TRAPS TO REDUCE BOLLWORM POPULATIONS IN  
REEVES COUNTY, TEXAS<sup>1/</sup>

By Alton N. Sparks<sup>2,3/</sup>

Reeves County is located in the arid southwestern part of Texas. Before the late 1940's and the early 1950's, most of the farming consisted of growing alfalfa for hay and seed. After World War II, Reeves County was in a land boom, and large areas of desert were grubbed, deeply plowed, and leveled. Irrigation wells were drilled, and the county became a major cotton producing area.

In 1965 about 58,000 acres of cotton were allotted to the growers in the county, but a Federal domestic acreage program limited the area planted to an estimated 46,000 acres. In this area, about 16,000 acres were involved in an insect control program in which traps equipped with blacklight lamps were used to control lepidopterous species, mainly the bollworm, Heliothis zea (Boddie), and the tobacco budworm, Heliothis virescens (F.).

Light trapping had been used on a much smaller scale in 1964 when, according to a distributor of insect traps, about 4,000 acres of cotton were surrounded by light traps. In 1965

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<sup>1/</sup> The research was in cooperation with the Texas Agricultural Experiment Station, Texas A & M University.

<sup>2/</sup> Entomologist, Entomology Research Division.

<sup>3/</sup> The author wishes to acknowledge E. L. Thaxton, Jr., agronomist, Trans-Pecos Experiment Station, and his associates for help in conducting the experiment, and the cooperation of all farmers in the area for making their fields available for the study.

about 2,000 traps of four basic designs (Agri-Light F-1034, Agri-Light LS-15, Lethalite, and homemade) were located in a belt 12 miles wide and 35 miles long, extending from 2 miles west and 3 miles north of Pecos south to Balmorhea. Most of these traps were in operation from the time of preplanting irrigation until the first killing frost. Planned experiments were conducted near the center and on the extreme ends of the belt to determine the effectiveness of the traps in controlling lepidopterous insects.

The results of these experiments and observations peculiar to this type of investigation are discussed in the paragraphs that follow.

## METHODS, MATERIALS, AND RESULTS

Electric insect traps were sold to the farmers on the premise that *H. zea* oviposition in trapped fields would be reduced sufficiently to require fewer applications of insecticides. No claims of total control were made.

### Experiment 1

Experiment 1 was a comparison among one untrapped and three trapped fields. Lethalite, Agri-Light LS-15, and homemade insect traps were installed on the periphery of the trapped fields.

#### Design

The experiment was conducted on the extreme northern end of the 12- by 35-mile, north-south belt of light traps. The primary objective was to compare oviposition counts taken at relatively frequent intervals throughout the season from trapped and untrapped fields. All counts were taken in one section of each field. The section of the trapped fields selected for observation was bordered on at least two sides by the same type of trapping system. Twenty 25-plant samples per field were taken in each of four fields at irregular intervals throughout the season. Fields are identified as Crowley's, Sullivan's, Miller's, and Lumpkin's (fig. 1).



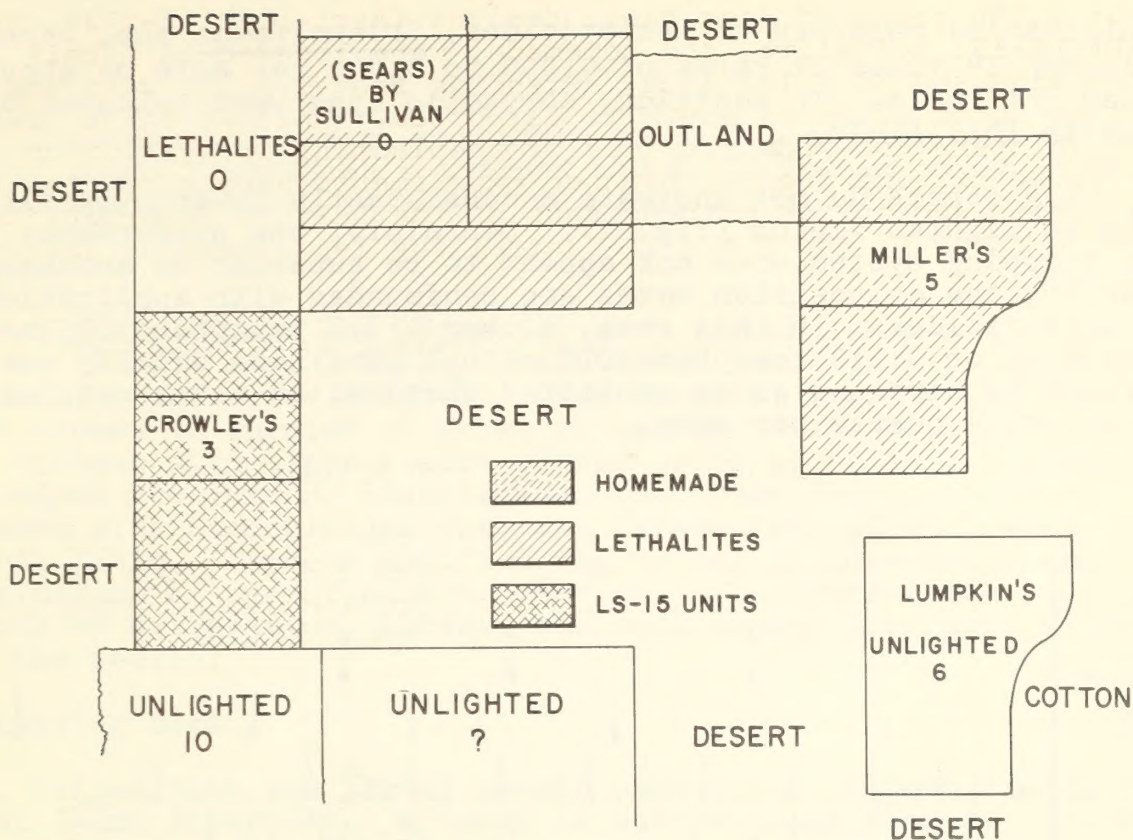


Figure 1.--Features of the area in which seasonal oviposition records for *H. zea* were taken from one untrapped and three trapped fields. Numerals in fields refer to the number of insecticide applications in the 1965 season. Drawing is not to scale.

### Collecting Data

Two men starting at different locations in a field each made ten 25-plant sample counts to determine and record numbers of *H. zea* eggs and larvae present. Early in the season counts were taken on the entire plant. Later, only terminals of the plants were considered in the counting procedure.

### Results

The results of egg counts are shown in figure 2. Arrows in the illustration pointing toward the X coordinate indicate the dates of insecticide applications. Arrow shafts were drawn in the same legend as was used to represent the egg count in a given field. Insecticide applications per study field are shown in figure 1. Although the field with the Lethalite installation

(Sullivan's) received no insecticides, Trichogramma spp, were released 14 times at rates of 4,000 to 8,000 per acre on about 7-day intervals. In addition, chrysopid eggs were released one time in this field.

Egg counts do not indicate a consistently lower oviposition rate in lighted fields (fig. 2). Certainly, the performance of one trapping system does not appear to be superior to another. However, the oviposition rates are confounded with applications of insecticides. In this area, either 4:2:1 toxaphene:DDT:methyl parathion or 3:1:3 toxaphene:DDT:methyl parathion usually was applied by airplane as an undiluted chemical at rates ranging from 2 to 4 quarts per acre.

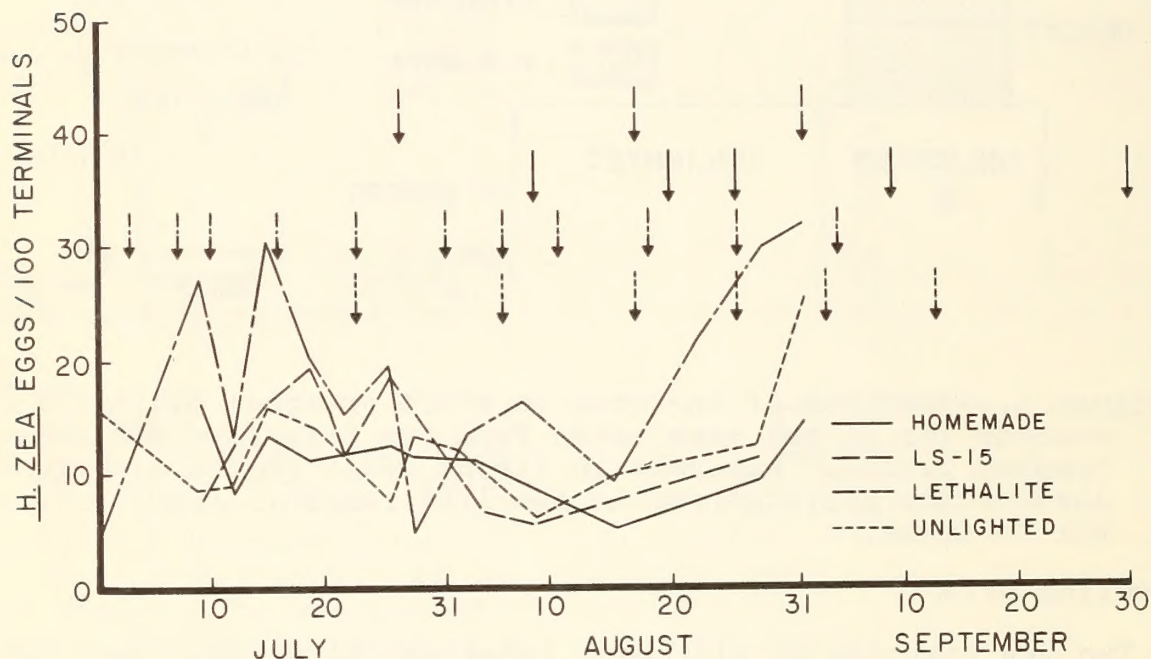


Figure 2.--Oviposition records for H. zea from one un-trapped and three trapped cotton fields.

Thus oviposition records taken at irregular intervals in trapped and untrapped fields failed to indicate that the trapping program consistently produced lower oviposition counts. In addition, no definite differences were detected in oviposition rates in fields where the three designs of traps were used.



## Experiment 2

Experiment 2 was a comparison of *H. zea* oviposition and larval count records in a trapped and an untrapped field utilizing chemical control versus no chemical control.

### Design

The experiment was conducted near the southern end of the 12- by 35-mile area. Large fields about one-half mile apart were chosen for the study (fig. 3). Two farmers, Frazier and Leigh, each agreed to furnish 40 acres of cotton. Each 40-acre field was divided into eight 5-acre plots. Four plots in alternate positions received no insecticide; the other four plots were treated with insecticides when the farmer treated the remainder of his field. Farmers notified the writer in advance of each application of insecticide so that he could observe the procedure. Counts of oviposition, larvae, and boll damage were made throughout the season.

### Collecting Data

Oviposition and larval counts were taken in both fields at about 3-day intervals. A total of six 25-plant samples (three per man) were taken from randomly selected areas in each 5-acre block.

Damage counts were taken by randomly selecting 25 single plants per sample. Two samples were taken in each of the eight plots per field after insecticide applications began; sampling continued at irregular intervals throughout the season. Numbers of bolls, blooms, and squares and the injury to each fruiting form were recorded. The final boll damage count was taken by randomly selecting three 1/2000-acre samples for each treated and untreated plot.

### Results

Figure 3, though not drawn to scale, indicates fairly accurately the trapped and untrapped cotton fields in the area.

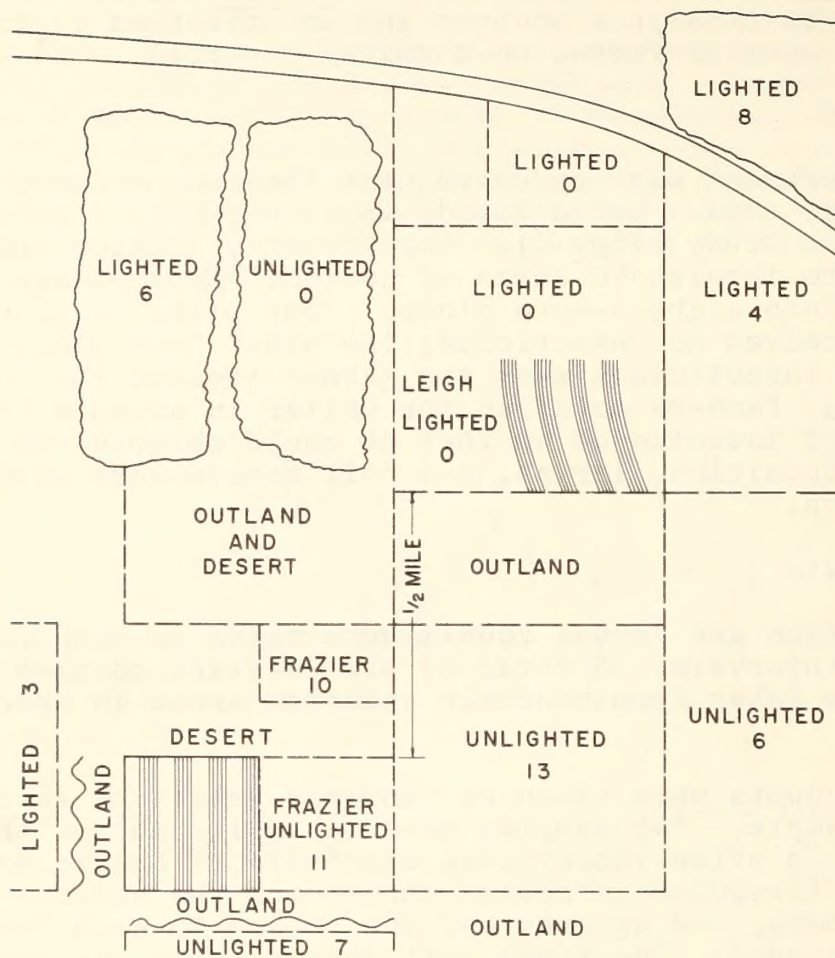


Figure 3.--Area in which the effects of insecticides vs. no insecticides and of traps vs. no traps were tested on oviposition and larval infestation by *H. zea*. Numerals refer to the number of insecticide applications made in the 1965 season. Drawing is not to scale.

Figure 4 shows the seasonal egg count in both the lighted and unlighted fields. Again, the arrows pointing toward the X coordinate indicate when insecticide was applied to the untrapped field. In addition to the 10 designated applications, an undesigned application of 1/2 pint Bidrin (3-hydroxy-N,N-dimethyl-ciscrotonamide dimethyl phosphate) per acre was applied on May 28. No insecticides were used on the trapped field. The egg count record indicates that the insect traps were as efficient as the 10 applications of insecticides in keeping the egg count under control. Also little if any difference appeared to exist in the attractiveness of insecticide treated blocks versus untreated blocks of cotton as sites for oviposition by H. zea moths.

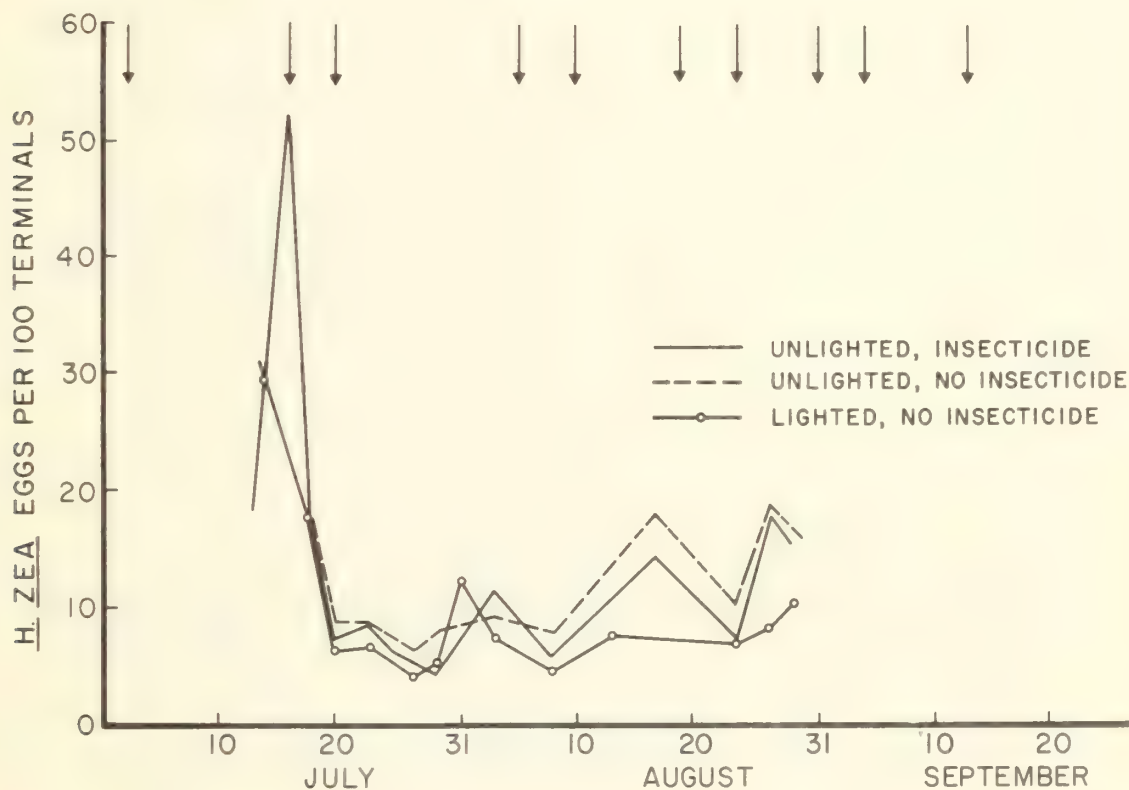


Figure 4.--Oviposition records from trapped vs. untrapped and from treated vs. untreated plots of cotton.



The seasonal larval counts for both fields are shown in figure 5. Again, the light traps appeared to be as effective as the 10 applications of insecticide in controlling populations of *H. zea* under the conditions of this experiment. Larval counts in the insecticide treated plots compared with those from untreated plots in the untrapped field show that nothing kept the bollworm population on the untreated plots under control. Early in August, the number of larvae per 100 terminals on the untreated, untrapped plots averaged slightly more than 30; most of the larvae were fifth and sixth instar. These large larvae had eaten practically all the fruit and were actually chewing the terminal 4 to 6 inches of the plant.

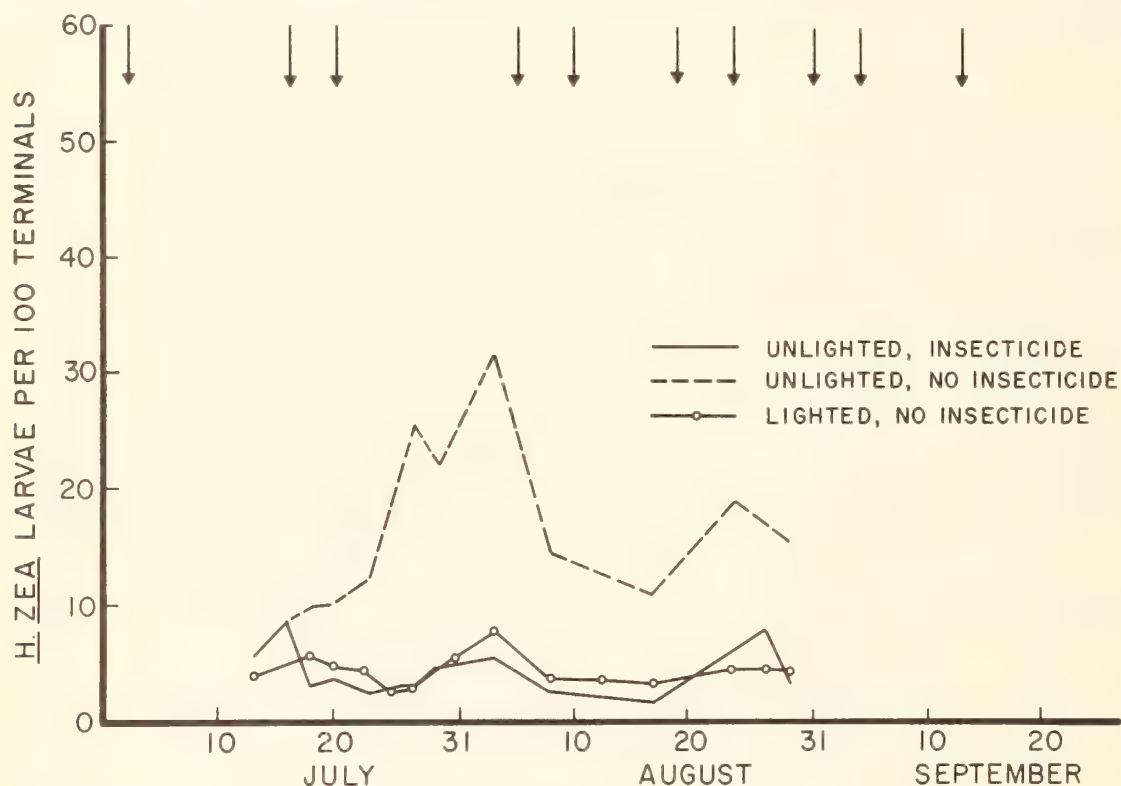


Figure 5.--Larval records from trapped vs. untrapped and from treated vs. untreated plots of cotton.

Table 1 shows the damage counts taken during August and September. The initial counts were made to establish differences in control between treated and untreated plots within a given field. Thus, no counts were taken in the trapped field because no insecticides had been applied. The changes in percentage of damage to each type of fruiting form from time to time are interesting. However, little meaningful data can be abstracted from bloom and square damage counts after the season is over. Probably the most useful data in the table pertain to the numbers of bolls and the percentage of damage to these bolls recorded at each inspection date.

Table 1.--Damage in a trapped field and in an untrapped field with insecticide treated and untreated plots

Date sampled	Plot designation	Samples		Damage in untrapped fields --						Damage in trapped fields --					
				To bolls		To blooms		To squares		To bolls		To blooms		To squares	
		Number	Size	Number	Injury	Number	Injury	Number	Injury	Number	Injury	Number	Injury	Number	Injury
Aug. 6	Treated	4	50 plants	152	Pct. 7.9	146	Pct. 15.2		Pct. 18.1		Pct. --		Pct. --		Pct. --
	Untreated	4	50 plants	44	40.9	17	0.5	270	19.1	--	--	--	--	--	--
Aug. 13	Treated	4	50 plants	197	10.2	50	18.0	272	23.1	--	--	--	--	--	--
	Untreated	4	50 plants	61	34.4	41	53.7	215	45.6	--	--	--	--	--	--
Aug. 23	Treated	4	50 plants	350	16.3	32	37.5	164	12.2	--	--	--	--	--	--
	Untreated	4	50 plants	78	37.2	23	0.4	655	22.7	820	8.5	78	19.2	375	22.1
Sept. 23	Treated	12	1/2000 acre	1201	1.9	--	--	--	--	--	--	--	--	--	--
	Untreated	12	1/2000 acre	341	22.0	--	--	--	--	1568	7.2	--	--	--	--

### Experiment 3

Experiment 3 was a comparison of oviposition and larval counts in an untrapped field and in a trapped field where the traps were placed in concentric circles within the field.

#### Design

Seventeen traps arranged in two concentric circles of eight traps and one trap in the center were located in a 122-acre cotton field (fig. 6). The arrangement formed eight spokes with traps spaced at intervals of 550 feet along the spokes. In addition, four timed-interval traps were located on each corner of the field, at least 550 feet from any other trap. Each flag in figure 6 represents the site where oviposition counts were taken from 10 plants on alternate days. Forty flags arranged in a similar design were used to mark sites where oviposition counts were also made in an adjoining unlighted field on alternate days.

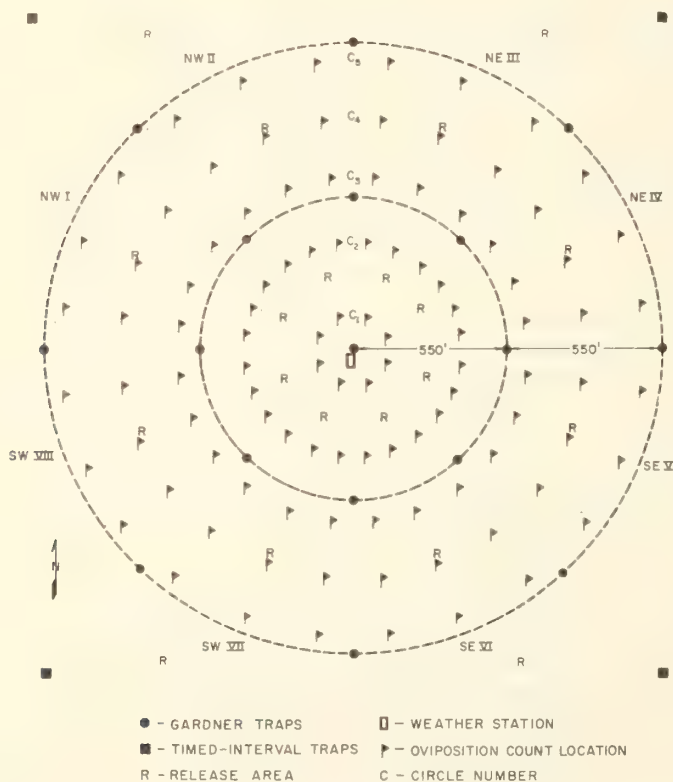


Figure 6.--Diagram showing concentric arrangement of traps and location of ovipositional check plants in a 122-acre cotton field.



## Collecting Data

As noted, oviposition and larval counts were made on alternate days in the two fields by locating the flagged sites and counting the eggs and larvae of H. zea on 10 plants per site.

## Results

Seasonal counts of eggs and larvae of H. zea in the trapped and untrapped fields are shown in figure 7. Arrows pointing toward the X coordinate and drawn in the same legend as the chart lines indicate insecticide application dates for the trapped and untrapped fields. These data indicate that oviposition in the trapped field was somewhat lower when egg counts were relatively low. However, when oviposition counts in general were increasing, the counts also increased in the trapped field.

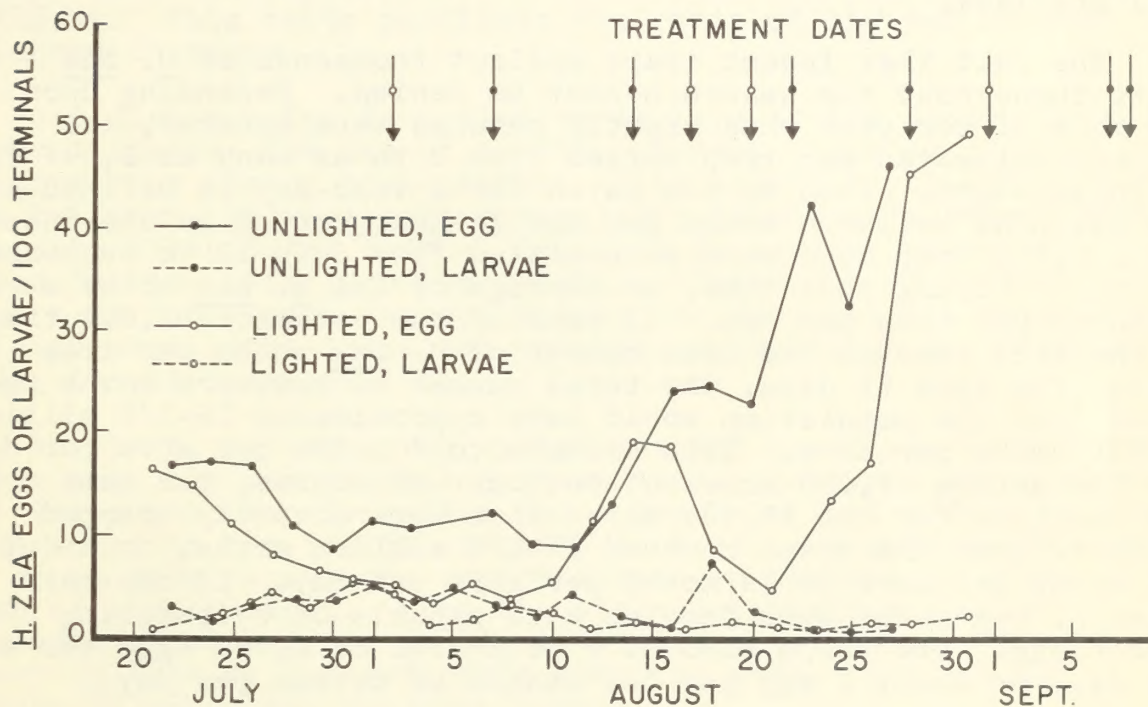


Figure 7.--Records of seasonal egg and larval counts made in an untrapped field and in a field in which the insect traps were arranged in concentric circles.



Larval counts in the two fields appear similar, with neither becoming excessively high. The untrapped field was treated six times with insecticide during the season; the trapped field was treated four times.

## DISCUSSION

The population of injurious lepidopterous insects was considered low in the Reeves County area in 1965. Advocates of light traps contend that this decrease was caused by the trapping system. However, oral reports by members of the Heliothis Research Exchange meeting in New Orleans, La., in December 1965 indicated that the population density of H. zea was low throughout its distributional range. The best index to the relative population sizes of H. zea in Reeves County in recent years comes from figures of gross receipts of insecticides sold and applied by one of the more stable of the dealer-applicators of aerial insecticides. Assuming the company received its normal share of business, gross receipts from sales and services indicate that the 1965 bollworm population was only 35 percent as great as in 1963 and 1964.

The fact that insect traps collect thousands of H. zea moths throughout the season cannot be denied. Depending upon the time of the year when nightly catches were counted, the numbers collected per trap varied from 0 to as many as 1,047 for a single night. Then if the catch for a trap-day is defined as the catch of bollworm moths for one 24-hour period in one insect trap, 1,635 trap-days were accumulated from July 18 to September 6, 1965. During this time, an average of 151 H. zea moths were captured per trap per day. If each of the estimated 2,000 traps in the area removed the same number of H. zea moths per trap during the same 51 days, the total number of bollworm moths removed from the population would have approximated 15-1/2 million, or 335 moths per acre. This amounts to 7 moths per acre per day for the entire 46,000 acres of cotton. Of course, the same calculations for the 16,000 acres that were actually trapped indicate that the traps removed 15-1/2 million moths, or about 960 moths per acre or 19 moths per acre per day. If one-half these H. zea moths were females each capable of ovipositing 200 viable eggs, the traps removed a potential of 1,700 eggs per acre per day, or about 1 egg per 200 stalks of cotton per day.

The writer believes these data indicate that the 2,000 electric insect traps operating in Reeves County, Texas, in 1965 had an impact on the entire population of H. zea in the area rather than on populations in individual fields. That is, the estimated 15-1/2 million H. zea moths captured during 51 days in 1965 probably were trapped from 46,000 acres of host plants rather than from the 16,000 trapped acres.



When sex ratio of the bollworms removed from light traps was noted briefly late in July and early August, it was found to be so near 50:50 that the sex of the moth was disregarded after a few days. Female H. zea were neither depleted of eggs nor incapable of ovipositing when they were attracted to the traps. Also casual observation to determine how the insects entered the traps revealed that the catches included bollworm moths of all categories of physical fitness. Almost all females inspected showed evidence of being potential egg producers. Females collected from traps, placed in an oviposition cage, and supplied with beer, oviposited abundantly. One such female, the only insect trapped one evening between 8 and 9 p.m. in one of the timed-interval traps, laid 258 eggs in the container before succumbing to the weak cyanide fumigant in the container. Admittedly, the insect was under stress. However, she was attracted to the light trap and was capable of ovipositing this large quantity of eggs in a short time.

Data obtained from the weekly larval collections (table 2) indicate that the percentage of H. virescens (compared with H. zea) in field populations was extremely small until the last of August. This ratio parallels the ratio of the two species collected in traps.

One discouraging fact discovered late in the season is an argument against the use of electric insect traps to control lepidopterous insect populations. With denser populations, the pink bollworm, Pectinophora gossypiella (Saunders), became more generally distributed than it had been in several years in Reeves County. The increase greatly concerned most cotton growers in the area. Farmers having the most trouble were those that had used light traps and very few insecticide applications during the 1965 season.

In short, the trapping system was not particularly effective in one test but was promising in another. However, the mere fact that traps had been installed had a psychological effect on the farmers and on the insect checkers (insecticide sales-servicemen) and could have caused the reported reduced numbers of applications of insecticides. When the overall injurious insect populations are low, as in the 1965 season, the psychological effect is hard to separate from the real value that should rightly be given the trapping system.

The system of using traps equipped with blacklight lamps to reduce insect populations is certainly not a cure for all the insect problems of cotton growers; neither is it something to be overlooked.



Table 2.--Summary of weekly larval collections made in Reeves County, Texas, 1966

Collection dates	Total larvae collected	Kind, number, and percent of larvae									
		Bollworms ( <i>H. zea</i> )		Budworms ( <i>H. virescens</i> )		Parasites		Escapees		Dead	
		Number	Pct.	Number	Pct.	Number	Pct.	Number	Pct.	Number	Pct.
Before July 18.	362	274	75.7	2	0.5	36	9.9	26	7.2	24	6.6
July 18 to July 24.	379	245	64.6	2	0.5	46	12.1	53	14.0	33	8.7
July 25 to July 31.	361	240	66.5	5	1.4	34	9.4	52	14.4	30	8.3
Aug. 1 to Aug. 7.	243	147	60.5	3	1.2	9	3.7	30	12.3	54	22.2
Aug. 8 to Aug. 15.	232	155	66.8	6	2.6	18	7.8	24	10.3	29	12.5
Aug. 16 to Aug. 21.	370	168	45.4	16	4.3	72	19.5	84	22.7	30	8.1
Aug. 22 to Aug. 28.	278	128	46.0	27	9.7	43	15.5	56	20.1	24	8.6
Aug. 29 to Sept. 4.	405	226	55.8	109	26.9	21	5.2	34	8.4	15	3.7